Task 1
Section 3 through Section 6 of The Economist's 2017 article "Quantum Technology is Beginning to Come into Its Own."
https://www.economist.com/news/essays/21717782-quantum-technology-beginning-come-its-own

Done by Marianna
1. According to the article, how do ambitions for quantum networks differ across nation-states around the world, and why? Include your own convictions about what role quantum networks should play.

“The future of technology lies in quantum networks”. Many investing companies and government organizations around the world believe that the quantum internet is something special that enables individuals and corporations to collaborate in a more trustworthy and private way.

According to the “Quantum technology beginning come its own” article China is one of the most ambitious countries that invested into creating a quantum network at the end of 2016. Their project which connected Beijing, Jinan and Shanghai metro was over 70 sq km having 50 ‘nodes’, funded by their central government. The customers are the China Banking Regulatory Commission, the Xinhua news agency, and China Industrial and Commercial Bank.
The next goal was to link the Beijing, Jinan and Shanghai network to Urumqi (in Xinjiang province). So working with Huawei and Lenovo, China launched a satellite that had a quantum-key-distribution-enabled called “Micius”. Singapore, Italy, Canada, Japan and America tried to evolve satellite communications as well.

In comparison with China, the European Telecommunications Standards Institute (ETSI) aims to determine quantum-cryptography standards which is the base for the future development of the field. Scientists working in ETSI want to ensure consumers that the kits that they got from the vendors can cooperate together and are secure enough.

Many senders and receivers are connected via infrastructures which are growing between and within considerably big metropolitan areas. In contrast with the two examples we already discussed above the government of South Korea funds 250 km to connect already existing metro quantum networks. Also, in Great Britain a similar network of the same length will be established between Bristol, London and Cambridge.

We think that quantum networks being the base of the quantum internet can change the way of communication. As discussed previously quantum internet is much more secure, hence it can be applied in national security, energy delivery infrastructure, banking and securing any kind of sensitive data.

Done by Satenik

2. Give four reasons why corporations and governments believe "the time for investment, all agree, is now" for quantum computation, according to the article. Comment on which of the reasons you believe are most convincing.

Before 1994 the idea of developing quantum networks seemed fictional but everything drastically changed after american professor Peter Shor discovered a way to make the basic quantum computer. In addition, as we see in the article, more corporations and governments believe that time for investment in quantum networks is right now.

One of the reasons according to the article that the best time is now is the following: Quantum computers work completely differently rather than the traditional ones. Later ones work with bits that have either 1, or 0 as a value. On the other hand qubits, the quantum analogues for bits, gain a state being between 1 or 0. In other words qubits are the mixture of both. This principle is known as superposition.

Next reason lies in the other principle called entanglement. In a traditional computing system, bits are isolated from each other, which prevents miscomputations. While in the quantum computers qubits are entangled with each other and that entanglement of several qubits is supreme.

The other reason is that nowadays establishing a qubit is easy to cope with. The problem left is when the qubit is created it is requiries isolation from every other thing that plays a role in the experiment. As isolation can never be completely done errors will always flow in. In order for the calculation to be successful errors should always be considered and corrected. As time goes by the computers become much more powerful, so the number of qubits that should do logical operations such as calculation will be decreased in comparison with the number of qubits that are responsible for control-and-command and error-correcting.

For carrying million qubits it is needed to use Shor’s famed algorithm for sorting huge numbers used in encryption.

And last but not least, even the less capable and smaller in size machines will soon have the potential to make revenue. In the future as Feynman had in his mind quantum simulators can help making superconductors enabling electricity to work without losses.

In our opinion, out of four reasons presented, the most convincing one is that nowadays it is easier to make a qubit.

Done by Marianna
3. The article quotes IBM vice president Dario Gil saying, "The power of quantum computing is rediscovering all the problems that computers cannot solve, and having a path to solving them." Discuss three ways "quantum software" addresses this idea, and argue whether one should believe Dr. Gil's statement (or not).

IBM vice president Dario Gil stated that "The power of quantum computing is rediscovering all the problems that computers cannot solve, and having a path to solving them."

One of the ways quantum software addresses his statement is that as a co-founder of 1Qbit, Landon Downs puts down is that “By taking the lens of how you would formulate an algorithm on a quantum computer you often find very good improvements on classical algorithms.” Also, he finds that this is the way where success will come from.

The second way is through post-quantum cryptography which will enable the creation of cryptograms that even years later quantum machines will not be able to break.

And the last way is that every kind of post-quantum solution has a goal of having ????
“Keys for elliptic-curve cryptography, another current standard, are just 32 bytes long; any post-quantum solution needs to aim for a similar ratio of brevity to security.”

According to the article no general purpose quantum was developed till now, hence we cannot be sure that an algorithm running on a quantum machine will be runned better than in the classical computer. So, one cannot trust in dr. Gil’s statement as we are not sure whether or not a given algorithm will work better on a quantum computer than on the traditional one, then we cannot assume that the quantum computer can rediscover and solve an issue that a modern day computer cannot do.

Moreover, even if quantum machines are so powerful, we yet have to find out ways of using the power that they hold. As the author of the article mentions “we’re still interested in what you can do with a million or a billion qubits, but it’s interesting to see if you can figure out what you can do with 100.”

Done by Satenik

4. The article states "subjects that used to be mere footnotes to physics will rule, and engineers (and perhaps even consumers) will have to learn to speak quantum." How is this point presented in the article (cite corporate and government examples), and can you give examples from your own experience?

The article claims that "subjects that used to be mere footnotes to physics will rule, and engineers (and perhaps even consumers) will have to learn to speak quantum." Furthermore in the article we come across several engineering firms and governments who decided to implement quantum technology in their activities.

For instance, at Bosch which is known to be a huge engineering company, engineers came together and applied quantum technology in creating things like autonomous machines and the internet of things, like quantum cryptography for secure transmission, quantum sensors for collecting sensitive readings, and quantum computing in order to assemble perceptivity from resulting plentiful flows of data.

Another good example is how Element Six which is a subsidiary of a diamond giant used quantum technologies in it's production. As mentioned, the company "has carved out a niche selling diamonds with bespoke "nitrogen vacancies"—flaws that turn them into sensors. Silicon carbide is tipped to be just as quantum-amenable as those diamonds, but so far expertise with it is thin on the ground."

And finally, Intel which is a huge semiconductor manufacturing company wants to construct silicon that has cubits in it. This way the produced material would be in much higher purity hence with better quality. So, Intel has joined with two material firms which are Urenco and Air Liquide in order to reach this goal.

So, why do engineers need to speak the quantum language? As known, simulating nature, such as modeling atomic bondings, electronic orbital overlaps, or any other application in the field of chemical informatics expects the computer to deal with huge amounts of numbers. We as engineers need quantum computing in order to make faster computations that include large amounts of numbers. Simulating such systems directly onto a quantum computer would lessen the amount of time needed for a solution.